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JOB TITLE: Middle Missouri River Fisheries Evaluations

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ABSTRACT

A study to evaluate the present fisheries condition in the middle Missouri River was initiated in 1997 and continued during 1998. A total of 12,893 fish were sampled in the middle Missouri and lower Marias rivers representing 35 of the 47 species known to occur in this reach. Shorthead redhorse, goldeye, sauger, carp and river carpsucker were the 5 most abundant species comprising 70% of the fish sampled by electrofishing. Flathead chub, Hybognathus spp., emerald shiner, longnose dace and longnose sucker were the 5 most abundant species comprising 86% of the fish sampled by seining. Sauger catch rates averaged 4.6, 6.3, 8.2 and 23.9 fish/hr for Coal Banks, Judith Landing, Grand Island and Marias/confluence sections, respectively, during fall, 1997 and 1998. Individual sauger movements were monitored using radio telemetry and the upper-river group moved the most extensively averaging 12.7 miles/relocation with a maximum distance of 99.9 miles downstream from the release site. During spring, the upper-river group sauger moved an average distance of 23.1 miles/relocation.

INTRODUCTION

The middle Missouri River supports a diverse warmwater fishery. All of the native fish species that historically occurred here are still found in this reach because of the relatively unaltered state of the river. Berg (1981) conducted a planning and inventory study of the middle Missouri River 20 years ago and concluded that this reach supports a fishery with an exceptional recreational value. He also established baseline biological measurements of the fish populations for future status comparisons. There has been some noticeable changes in the fishery since Berg's study. Recently there has been concern about the drastic declines of sauger abundance in the middle Missouri River (McMahon 1999).

Pallid sturgeon are found in this segment of the Missouri River. They exist in low numbers throughout their geographic range (Kallemeyn 1983) as is the case here. In 1990 the U.S. Fish and Wildlife Service listed the pallid as endangered under the Endangered Species Act 1973. Reasons for listing are habitat modification and apparent lack of reproduction. Reports of pallid sturgeon sightings have also declined dramatically in the last 20 years (U.S. Fish and Wildlife Service, 1989). The pallid sturgeon has been listed as a class A "species of special concern" in Montana since 1973 (Holton, 1980).

The Montana Department of Fish Wildlife and Parks (FWP) studied the middle Missouri River population during the period 1990-95 and concluded that the population is endangered of going extinct within 10-20 years unless immediate actions are taken. Several years of study shows that only about 50 adult pallids remain and that the population is senescent. Moreover, there was no evidence of successful reproduction at least in the last 20 years.

The pallid sturgeon recovery plan calls for reintroducing pallid sturgeon in this area as a temporary remedy with the anticipation that hatchery-reared fish will eventually reproduce and maintain a viable population once habitat demands are met (Dryer and Sandvol 1993). In August, 1998, a total of 758 hatchery-reared, yearling pallid sturgeon (44 with radio transmitters) were released into the middle Missouri River for the first time. Evaluation of this reintroduction and habitat selection by these fish have now become the main focus of the pallid sturgeon investigation.

OBJECTIVES AND DEGREE OF ATTAINMENT

1. **Inventory fish populations in the middle Missouri River.** A total of 12,893 fish were sampled throughout the study area electrofishing for 55.4 hours and completing 103 seine hauls during 1997 and 1998. Results are presented.
2. **Determine the population status of sauger in the middle Missouri River. Establish population abundance trend areas, study seasonal movement patterns and evaluate reproduction success.** Four trend areas were sampled by electrofishing in the fall of 1998 and results are presented. Thirteen sauger, 7 walleye and 8 northern pike were radio tagged in the fall 1997 and monitored through fall, 1998. Movement patterns and species interactions were evaluated and results are reported. One hundred three seine hauls were completed during the summer 1997-98 for evaluating sauger reproduction success and results are presented.
3. **Evaluate the potential benefits for augmenting sauger numbers with hatchery-reared fish.** Attempts at spawning sauger in the wild began in spring, 1998, and was unsuccessful.
4. **Evaluate pallid sturgeon reintroduction efforts. Develop a systematic standardized sampling plan for evaluating population trends of subadult and adult pallid sturgeon in the study area. Monitor movement patterns, habitat use and survival of the juvenile pallid sturgeon stocked in the middle Missouri River.** The standardized sampling for monitoring changes in numbers of pallids in the trend area was not conducted in the fall of 1998 because the survey is scheduled biannually; the next survey will be conducted in 1999. A total of 44 hatchery-reared yearling pallid sturgeon were radio-tagged and released into the study. A report of the pallid movement patterns and habitat use is presented in the Section 6 Endangered Fishes Program Report (Gardner 1999). Assisted USFWS with the release of 714 pallid sturgeon in the 158-mile reach of the middle Missouri River.
5. **Review projects proposed by state, federal and local agencies and private parties which have the potential to affect fisheries resources and aquatic habitats. Provide technical advice or decisions to reduce or mitigate resource damage.** Attended the Upper Basin Pallid Sturgeon Work Group

meeting in Billings where pallid sturgeon researchers and interested agencies presented information and discussed the status of ongoing pallid sturgeon studies in Montana, North Dakota and South Dakota.

PROCEDURES

An electrofishing system was used to sample fish in the river. The system was a dual boom-type and mounted to a 17 or 19-foot aluminum boat powered by a 90 or 105 hp outboard jet motor. Electrical power was supplied by a 5,000-watt AC generator. The alternating current was delivered to a Coffelt Model VVP-10 rectifying unit which changes the alternating current to pulsed-DC. The positive electrode setup consisted of two fiberglass booms with 4, 18 inch pieces of stainless steel cable attached to each boom that extended from the end of the boom and into the water. The boat hull served as the negative. The unit was typically operated at 2-7 amps, 100-215 volts. Catch per unit effort for electrofishing was expressed as number of fish caught per hour. Electrofishing was not used for capturing pallid sturgeon, nor was this method used in areas of known pallid sturgeon concentrations.

All fish were measured to the nearest 0.1 inch (fork length for sturgeon and total length for all other fish), and weighed to the nearest 0.01 pound. Sauger, walleye northern pike and smallmouth bass were tagged with a Floy anchor T-tag. A spiny dorsal fin ray was extracted from sauger and walleye for aging purposes.

A 50 x 4 foot beach seine with a 1/4-inch mesh was used to survey the minnow populations and evaluate reproductive success of important fish species. Sampling was conducted in a variety of shoreline habitats and all captured fish were identified and counted and associated habitat type was recorded. The unit of effort was expressed as number of fish per seine haul and consisted of dragging the seine for approximately 100 feet in areas with water depths less than 3 feet.

A radio telemetry system was used to research the movement patterns of sauger, walleye and northern pike in the study area. A low frequency band receiver along with omni-directional and directional antennas were used to make contact with the transmitted fish. Field tests indicated that radio relocation accuracy was within 30 feet. An internal transmitter was surgically implanted into the body cavity of the fish. The 10 gram transmitter was 2 inches long with a 0.4 inch diameter and had a 300-day life. The transmitters were time programmed with a microprocessor to conserve battery life; the duty cycle was 12 hours on per day for 30 days, then off for 30 days. This cycle would repeat until the battery-life expired. Thirteen transmitters were implanted into sauger weighing between 1.67 and 3.5 pounds; 7 transmitters were implanted into walleye with weighing 1.90 to 6.7 pounds; and 8 transmitters were implanted into northern pike weighing between 1.8 to 8.5 pounds. The schedule for monitoring the radio-tagged fish is given in Appendix A.

DESCRIPTION OF STUDY AREA

The middle Missouri River study area consists of a 208-mile reach in northcentral Montana between Great Falls and the headwaters of Fort Peck Reservoir near Lewistown. There are two major tributaries entering the Missouri in this reach; the Marias River from the north and Judith River from the south. The present flow regimen of the Missouri River in the study area is not entirely natural because of regulation and storage at several upriver dams. Study site locations are shown in Figure 1 and Appendix B.

FINDINGS

River conditions

The 1998 flow conditions that occurred in the middle Missouri River and lower Marias River are summarized in Table 1. Overall water conditions in the middle Missouri River during 1997-98 were considered good for the aquatic ecosystem. Base flows during the winter, summer and early fall varied between 6,300 and 8,687 cfs and were well above the recommended minimum instream flow of 4700 cfs (Gardner and Berg 1982). In 1998 the maximum flow of 29,800 cfs surpassed the bankfull flow of 23,466 for several days and the paddlefish migratory "trigger" flow of 15,302 cfs was surpassed during the May 19 – July 5 period (Gardner and Berg 1982).

Table 1. Average monthly flow summaries for the Missouri River near Landusky and Marias River near Chester, 1998 (USGS 1999).

	Missouri River cfs	River percent ¹	Marias River cfs
Jan-Mar average flow	6,681 – 8,687	89 – 106%	484 – 494
April average flow	9,772	94%	483
May average flow	14,740	63%	496
June average flow	20,100	76%	599
July average flow	11,040	175%	925
Aug-Sept average flow	6,301 – 6,697	122-130%	925 – 930
Peak flow and date	29,800 Jul 4		954 Jul 13
Estimated bankfull flow	23,466 ²		3,936 ³

¹ Denotes percent of average compared to the record of past years.

² From Gardner and Berg 1982.

³ From Rood and Mahoney 1995.

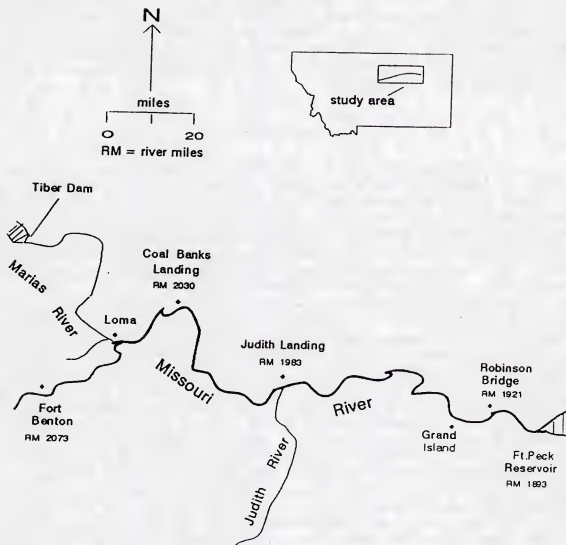


Figure 1. Map of study area.

Water run-off and storage conditions in the Marias River Basin were not as favorable compared to the middle Missouri River. The base flows in lower Marias River downstream of Tiber Dam were nearly at the recommended minimum instream flow of 500 cfs (Gardner and Berg 1983) during the winter and spring months and base flows were well above the recommended minimum during the remaining year. The late peak flow of 954 cfs in 1998 was considerably less than the estimated bankfull flow of 3,936 cfs (Rood and Mahoney 1995), however, the bankfull flow was recently surpassed in 1997. Rosgen (1996) recommends that a bankfull flow should occur about every 5 years for channel maintenance.

Temperature conditions

Along with unnatural flow conditions, altered water temperature regimes are also a concern downstream of a large dam (Ward and Stanford 1979). The concern about water temperatures in the study area is that the lower Marias River may be abnormally cooler because of hypolimnion releases dominating the dam discharge most of the time. The coolwater releases could affect spawning use by migratory fish from the Missouri River. The Marias River station near Shelby and the Missouri River station near Loma were used as comparative stations assuming these sites represent more normal conditions. Water temperatures were monitored at 6 sites and summary results are given in Table 2. Temperature curves for the individual stations are shown in Appendix C.

Average monthly temperatures were consistently the coolest at the Tiber Dam station for the months of April through September most likely as a result of the hypolimnion releases at Tiber Dam. Average monthly temperatures immediately below the dam never exceeded 56.6 F during this period. Circle Bridge temperatures were also cool, but not to the magnitude of Tiber. The Circle Bridge highest average monthly temperature reached 60.6 F in August. Black Coulee and Confluence stations recorded average monthly temperatures similar to those measured at the station above Tiber and the Missouri River station near Loma for the period April through July. Overall, water temperatures in 1998 were generally warmer than that recorded for 1997. For instance, at the station above Tiber Reservoir mean monthly temperatures averaged 4.3 degrees warmer during 1998.

The Marias River serves as an important spawning tributary for several Missouri River fish species and a change of water temperature patterns in the Marias could negatively impact the migratory fisheries. Most of the migratory spawning use in the Marias occurs from April through June. The temperatures recorded in 1998 for the lower two sites in the Marias (Black Coulee and Confluence) appeared to be well within the desirable ranges for spawning for species such as sauger, shovelnose and blue suckers. Moreover, the temperatures recorded at Black Coulee and Confluence were warmer than the above Tiber station April, May, June and October. It appears that the cool water release from Tiber Dam did not cause abnormal temperatures in the lower 30 miles of the Marias River during 1998.

Table 2. Mean monthly water temperatures for the Marias River upriver of Tiber Reservoir (RM 116.8), below Tiber Dam (RM 75.1), Circle Bridge (RM 57.9), Black Coulee (RM 28.5), and Confluence (RM 1.0) and Missouri River near Loma (RM 2052.8) stations, 1998.

	April	May	June	July	Aug.	Sept.	Oct.	Total # temp. meas
Above Tiber Reservoir	51.8	57.2	59.8	73.1	71.7	64.3	48.1	4670
Below Tiber Dam	42.8	46.8	49.1	52.7	55.5	56.6	55.8	1454
Circle Bridge	48.5	54.2	55.8	60.4	60.6	58.7	53.5	4664
Black Coulee	52.4	60.0	61.4	68.2	66.6	61.2	51.1	4691
Confluence abv Teton R.	54.2	62.2	63.4	71.1	68.3	62.7	51.3	4692
Missouri R. abv Marias	49.7	58.0	59.9	69.9	71.0	65.3	52.2	4691

Fish populations

Electrofishing.

General fish populations in the study area were last monitored nearly 20 years ago when Berg (1981) completed an intensive planning and inventory of the fisheries resources in the middle Missouri River. Therefore it is now important that the fisheries be re-surveyed to determine population trends and evaluate if the present management for the fisheries is appropriate for maintaining the fish populations at optimal levels. Two methods were used to evaluate the fish communities. The first method was fall electrofish sampling in established 6-mile segments located at Coal Banks Landing (RM 2030), Judith Landing (RM 1983), Grand Island (RM 1930) and Marias River near Loma (RM 6). This method worked best for evaluating the adult fish population or fish greater than 10 inches. Catch rates and size statistics were used to evaluate the population condition. The second method used was summer seining in the shallow river habitats throughout 175 miles of the study area. This method worked best for evaluating the juvenile fish and the cyprinid portion of the fish communities. Catch rates and presence/absence were used to evaluate the population condition.

Totals of 1,353 and 1,524 fish were sampled in 1997 and 1998 while conducting the fall Missouri River electrofish surveys. Average catch rates and size statistics for each section are given in Tables 3 and 4 and Appendix D and E. Thirty species were sampled in the 5 sections combined, with the greatest number (23) recorded at Coal Banks. Shorthead redhorse, goldeye, sauger, carp and river carpsucker were the 5 most commonly sampled species comprising 29.5, 14.9, 10.4, 9.1 and 9.0 percent of the fish captured for both years combined, respectively. These results are comparable to that reported by Berg (1981) nearly 20 years ago for the middle Missouri River. He found that goldeye, shorthead redhorse, longnose sucker, sauger and carp were the 5 most commonly sampled species comprising 36.0, 24.4, 11.5, 7.5 and 6.5 percent of the fish sampled, respectively. It appears fish compositions are similar for 3 of the 6 species compared to that of nearly 20 years ago.

Notable exceptions were a 59% decline in goldeye composition, 91% decline in longnose sucker composition and a 273% increase in rivercarpsucker composition

A total of 335 fish representing 15 species were sampled in 1998 while conducting the fall electrofishing survey in the Marias River near the confluence. Sauger, shorthead redhorse, goldeye, walleye and longnose sucker were the 5 most commonly sampled species comprising 40.6, 12.8, 12.2, 10.2 and 5.4 percent of the fish captured, respectively. Although sampling efficiencies are much more effective in the smaller Marias River compared to the Missouri, it appeared that sauger were more abundant in the Marias. Sauger catch rates were 23.9 for the Marias compared to 3.8 - 10.5 for the Missouri River sections. This difference could be related to the slightly greater water turbidities that is characteristic of the Marias during the summer and fall. The Marias River had a secchi reading of 1.2 ft during the survey on September 30, compared to a 2.0 ft secchi on October 1, in the Missouri River 67 miles downriver at Judith Landing. Sauger are known to prefer turbid conditions (Scott and Crossman 1973) and therefore, the relatively turbid Marias River may be attracting sauger. Gardner and Berg (1982) sampled this section nearly 20 years ago and found sauger, longnose sucker, mountain whitefish, goldeye and shorthead redhorse were the 5 most commonly sampled species comprising 56.7, 17.6, 10, 5.3 and 2.6 percent of the fish captured, respectively. Similarities between the two sampling records are the continued dominance of 4 of the 5 species and the occurrence of sauger in high numbers. Differences between the two years are the decrease in the composition of whitefish and increase in composition of walleye.

Eleven of 13 game fish species known to occur in the study area were sampled while conducting the fall electrofishing surveys. Only 4 game species, the sauger, walleye, channel catfish and northern pike comprised 1% or greater of the total fish captured in the 1997-98 surveys. Sauger were by far the most abundant game species sampled at the Coal Banks, Judith Landing and Grand Island sections during 1997-98 averaging 7.0 sauger/hr. Walleye were the most abundant game species sampled at the upper two sections, Fort Benton and Loma during 1997 averaging 3.8 walleye/hr. Chinook salmon were sampled at Judith Landing making this the first record for the species in the middle Missouri River. The two 15 + pound sexually mature females were sampled on October 8, 1997 and October 1, 1998, and obviously were migrants from the Fort Peck Reservoir population.

Seining.

The seining survey results are presented in Table 5. Locations of the sampling sections are given in Appendix B. A total of 9,681 fish representing 26 species were sampled during summer, 1997-98. Sampling was directed at a variety of shallow water habitats in main channel borders, main channel pools, side channel borders, side channel pools and backwaters representing 31, 25, 13, 17 and 14 percent of the total effort, respectively. The four species, emerald shiner, flathead chub, longnose dace and longnose sucker were commonly sampled at all sections with an overall average catch rate greater than 11 fish/haul (Table 5). The Hybognathus group (western silvery, plains and brassy minnows) were especially abundant at the lowest section, Robinson Bridge. Compared to a previous seining survey, Gardner and Berg (1982) found these 5 species including juvenile shorthead redhorse to be the most common species present. Young-of-the-year (YOY) channel catfish, northern pike, sauger, smallmouth bass and walleye were the game fish species that were seined indicating that successful reproduction of the species occurred in the river during 1997-98. Numbers of (YOY) sauger seemed to be considerably less in the 1997-98 survey compared to past years. Only 14 (YOY) sauger were seined in the Robinson Bridge Section during the 1997-98 surveys. The low 1997-98 catch rate of 0.3 sauger/haul in the Robinson Bridge Section was considerably lower than 1.5 and 2.1 sauger/haul found in 1979 and 1994, respectively (Gardner and Berg 1982 and Gardner 1995).

Table 3. Average fall catch rates (no./hour) and number of fish sampled by electrofishing in the middle Missouri River, MT, fall 1997.

	Fort Benton	Loma	Coal Banks	Judith Landing	Grand Island
Black crappie			0.1	2.6	1.5
Blue sucker				0.2	0.2
Brown trout		1.3			
Burbot				0.4	0.4
Carp	6.9	11.3	11.3	2.8	4.7
Channel catfish	0.3		1.6	3.3	2.3
Chinook salmon				0.2	
Emerald shiner	1.8		0.6		0.6
Flathead chub	0.6		2.3	0.2	0.9
Freshwater drum	1.8		4.7	0.4	0.2
Goldeye	6.1	2.7	5.3	0.6	13.2
Hybognathus spp.					0.2
Longnose sucker	1.9	1.3	1.4		
Mountain whitefish	0.3		0.3		
Northern pike	0.3		0.9	1.7	0.9
Rainbow trout	0.5	2.7	0.1	1.1	
River carpsucker	3.2	4.7	7.4	6.5	8.3
Sauger	0.5	2.0	5.3	7.4	5.9
Saugeye					0.2
Shorthead redhorse	20.2	34.7	20.6	17.8	7.6
Shovelnose sturgeon			0.1		
Smallmouth bass	0.3	0.7			
Smallmouth buffalo	0.2	0.7	0.3		0.4
Spottail shiner	0.2		0.3	0.2	
Sturgeon chub					0.2
Walleye	0.8	6.7	2.4	2.0	1.9
White crappie			1.7	1.7	
White sucker	1.9	0.7	0.3	0.4	0.4
Yellow perch			0.2	0.2	0.2
Total no. fish	297	104	457	230	265
Total no. hours	6.2	1.5	7.0	4.6	5.3

Table 4. Average catch rates (no./hour) and number of fish sampled by electrofishing in the middle Missouri River, MT, fall, 1998.

	Marias River Conflu.	Coal Banks	Judith Landing	Grand Island
Black crappie			0.2	2.4
Blue sucker		1.0	0.1	
Brown trout	0.2			
Burbot		0.2	0.4	0.2
Carp	0.5	5.0	4.6	1.3
Channel catfish		1.2	1.5	5.4
Chinook salmon			0.1	
Emerald shiner		0.2	0.1	
Flathead chub	2.5	2.4	3.5	0.4
Freshwater drum	0.2	7.3	2.1	0.2
Goldeye	7.2	16.5	13.6	5.9
Hybognathus spp.		0.1		
Longnose sucker	3.2	2.0	0.5	0.2
Mountain sucker		0.1		
Mountain whitefish	0.7	0.1	0.1	
Northern pike	1.1	0.4	0.4	0.6
Rainbow trout				0.2
River carpsucker		4.0	2.4	5.0
Sauger	23.9	3.8	5.2	10.5
Saugeye	3.0			1.1
Shorthead redhorse	7.5	34.2	10.4	5.3
Shovelnose sturgeon		0.1		
Smallmouth bass		0.1		
Smallmouth buffalo		1.9	0.5	0.1
Stonecat	0.2			0.2
Walleye	6.0	1.4	2.8	0.6
White crappie			0.2	
White sucker	2.1	0.1	0.2	
Yellow perch	0.7	0.1	0.3	
Total no. fish	335	692	505	327
Total no. hours	5.7	8.4	8.5	8.2

Table 5. Average catch per seine haul of fish sampled in the middle Missouri River, 1997-98. (The "y" denotes young-of-the-year).

	Fort Benton	Loma	White Rocks	Stafford Ferry	Robinson Bridge	Total # Fish
Black crappie y					0.2	9
Bigmouth buffalo y					Tr.	1
Carp y	0.7	0.1			2.4	125
Channel catfish y				0.3	0.2	13
Emerald shiner	19.7	5.7	15.8	17.2	22.0	1,791
Flathead chub	0.8	31.1	15.8	56.8	27.2	2,641
Fathead minnow	5.0	3.6	2.3	11.3	0.2	221
Freshwater drum y		Tr.			Tr.	3
Goldeye y					0.1	7
Hybognathus spp.				10.2	38.8	2,038
Lake chub	1.7	0.2	2.1	10.0		119
Longnose dace	62.7	27.4	7.3	5.5	0.3	1,078
Longnose sucker y	27.7	9.0	14.0	5.2	2.9	815
Northern pike y	0.3				0.1	6
River carpsucker			0.1	1.7	0.3	25
Sauger y					0.3	14
Sicklefin chub					Tr.	1
Shorthead rehorse y	10.0	0.3	0.6	2.2	0.2	102
Smallmouth bass y		Tr.				1
Smallmouth buffalo y					0.1	7
Spottail shiner		Tr.	0.1		0.1	11
Stonecat			Tr.			1
Walleye y		0.1			0.1	9
White crappie y			0.2		0.2	12
White sucker y	10.2				1.3	127
Yellow perch y	0.5	1.1	1.5		0.2	65
Unidentified		0.3	11.9		3.4	439
Total catch	835	1,422	1,578	722	5,124	9,681
Total # seine hauls	6	18	22	6	51	103

Blue sucker, paddlefish, pallid sturgeon, sicklefin chub and sturgeon chub are 5 species in the study area listed as state Species of Special Concern. The pallid sturgeon is also federally listed as endangered. All except paddlefish were sampled during the 1997-98 field seasons. A total of 758 hatchery-reared yearling pallid sturgeon were released into the study area in summer, 1998. Results of the release are reported by Gardner (1999). Totals of 52 blue sucker, 1 sicklefin chub and 1 sturgeon chub were recorded while conducting the fall electrofishing surveys, summer seining surveys and the Marias River fishery study (Gardner 1998). Very few of the deep-water chub species were sampled because electrofishing and seining are ineffective sampling methods for capture of these species compared to sampling with a trawl (Gardner 1995).

Sauger.

The sauger is a native species and popular game fish residing in the middle Missouri River. Recent information indicates that the sauger population in the upper portion of the reach has undergone a severe decline since 1989. The decline in the upper river area is of concern because here is where Berg (1981) found the sauger to be the most abundant during 1976-79. Table 6 shows that sauger catch rates (CPUE) have declined 89, 93 and 58 percent at Portage Coulee, Fort Benton and Loma sections. However, catch rates at the 3 remaining lower river sections appear to have increased 28 - 183 %. The comparison with Berg's CPUEs for these lower river sections may not be entirely valid since his values are the results of sampling during spring summer and fall compared to sampling just in the fall for this study. I believe electrofish sampling in the study area is more effective in the fall because of improved efficiencies associated with cooler water temperatures. Therefore, if anything, Berg's CPUE values are an underestimate of sauger abundance when comparing with fall sampled data.

Table 6. Average electrofishing catch rates (#/hr) for sauger in the middle Missouri River.

Section	---- Average CPUE -----	
	1976-79	1989-Present
Portage Coulee	18.5 ^{1/}	2.0 ^{2/}
Fort Benton	6.7	0.5 ^{3/}
Loma	4.8	2.0 ^{3/}
Coal Banks	3.6	4.6 ^{4/}
Judith Landing	3.6	6.3 ^{4/}
Grand Island	2.9	8.2 ^{4/}

^{1/} - Survey years were 1976-79 & 1988 (Berg 1981 and Hill et al. 1998).

^{2/} - Survey years were 1989, 1991 & 1993-98 (Hill et al. 1998).

^{3/} - Survey year was 1997.

^{4/} - Survey years were 1997-98.

The number of sauger spawners using the Marias River, an important spawning stream, has declined over the years coinciding with the overall sauger decline in the upper river. Table 7 shows that average densities of spawners in the Marias during the period 1979 through 1988 ranged between 12.3 to 39.2 sauger/hr. The average densities of sauger spawners in recent years have declined to very low catchrates of 3.1 and 4.1 sauger/hr for the years 1996 and 1997. Unfortunately the Marias was not re-surveyed for spawning use until 1996 so the exact year when declines in the spawning population first occurred cannot be determined.

Table 7. Spring catch rates (CPUE= no./hr) of sauger electrofished in the Marias River – Confluence Section, 1979-97.

Date	<u>1979</u>				
CPUE	18.2				
Date	<u>1982</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>
CPUE	39.2	12.3	12.7	16.5	12.9
Date	<u>1996</u>	<u>1997</u>			
CPUE	3.1	4.1			

Sauger size and abundance statistics are given in Table 8. Historic data (1976-79) is also presented so these statistics could be compared to the past years when the sauger populations were considered to be healthier. Recent sampling (1997-98) shows that sauger average lengths range between 10.9 inches for the Marias River Section, and 14.0 inches for the Judith Landing Section. This size range appears to be fairly typical for sauger populations in other Montana Rivers (FWP 1997). Present sauger size compositions at all 4 sections are dominated by fish smaller than 14 inches. Sauger abundance appears to be better in the lower two sections, Judith Landing and Grand Island, and the Marias River. The high catch rate of 23.9 sauger/hr. reported for the Marias compared to the other 3 sections was probably related to the improved efficiencies while electrofishing in this smaller, more turbid river. Nonetheless, this catch rate is considerably greater than spring catch rates of 3.1 and 4.1 reported in 1996 and 1997. The Marias River appears to be an important fall staging tributary for sauger.

Sauger populations in the middle Missouri River appear to be depressed in the upper portion of the study area, possibly as far down river as Coal Banks (76 river miles). Moreover, sauger spawning in the Marias has been severely reduced and the numbers of sauger rearing in the river is almost non-existent. For these reasons it is warranted that management efforts be directed at determining the factor(s) that are limiting sauger numbers and initiate a program to restore the populations.

Table 8. Comparisons of average sizes, size composition and average catch rates for sauger electrofished at stations in the middle Missouri and lower Marias rivers.

Station	Year	Number sampled	Avg. total length (in)	Avg. wt. (lb)	Percent <14 inches	Percent 14+ inches	Sauger CPUE	CPUE of 14+ in. sauger
Coal Bks	1976-79	358	13.5	0.77	65 %	35 %	3.6	1.3
Coal Bks	1997	37	13.0	0.77	67 %	33 %	5.3	1.7
Coal Bks	1998	32	11.4	0.62	87 %	13 %	3.8	0.5
Judith L.	1976-79	189	11.9	0.59	---	---	3.6	---
Judith L.	1997	34	14.0	1.09	65 %	35 %	7.4	2.6
Judith L.	1998	47	11.6	0.60	80 %	20 %	5.2	1.0
Grand Is ^{1/}	1976-79	86	11.7	0.55	---	---	2.9	---
Grand Is.	1997	31	13.1	0.92	52 %	48 %	5.9	2.8
Grand Is.	1998	86	12.3	0.59	78 %	22 %	10.5	2.3
Marias R.	1998	136	10.9	0.45	93 %	7 %	23.9	1.7

Years 1976-79 from Berg 1981.

^{1/} - This section was called Robinson Section in Berg 1981.

In an effort to restore sauger numbers in the upper river a limited supplementation program was initiated. The goal was to stock 30,000 – 50,000 sauger fingerlings in Morony Reservoir located in the upper river, 33 miles upstream of Fort Benton. An attempt was made to spawn sauger on site and collect 250,000 eggs for incubation and rearing at the Miles City State Fish Hatchery. A sauger spawning area was located in the lower reach of the study area where fish were captured and staged for spawning purposes. A total of 126 sauger were sampled by electrofishing during the period April 21 – May 5. The average catch rate was 11.3 fish/hr. while sampling 11.2 hours in the 3-mile spawning area. Based on these findings, it appears there presently is a healthy spawning population in this area. The number and locations of other spawning sites in the study area are presently unknown. Walleye also were found spawning in this area, and were sampled at the rate of 18.9 fish/hr; 1.7 times greater than the sauger CPUE during this period.

A total of 112 female sauger in various stages of reproductive readiness and only 8 ripe males were classified for potential spawning. Only 4 of these females were ripe enough to be spawned with the 8 males. A total of 100,000 eggs were stripped and fertilized and transported to the hatchery. Three days later it was determined by hatchery personnel that most of the eggs did not get fertilized and the batch was discarded. No further attempts at spawning sauger were made because ripe male sauger could not be found. An attempt was made to genetically screen the sauger to insure that only

pure sauger were used for spawning. Personnel at Montana State University at Havre, MT were contracted to analyze tissue samples of the sauger used in the spawning program. The students used a polyacrylamide gel electrophoresis method to screen the samples which proved to be unreliable.

Telemetry.

Sauger, walleye and northern pike were radio tagged and tracked so that a basic understanding could be acquired of how these fish use the river for various life cycle purposes. A total of 13 sauger, 7 walleye and 8 northern pike were equipped with radio tags and tracked intermittently from October, 1997 to October, 1998. Totals of 100 sauger, 29 walleye and 26 northern pike radio relocations were collected on these fish. The number of relocations for walleye and northern pike were considerably less than for sauger and was probably the results of different behavior habits for the two former species. Walleye appeared to prefer deep pools and this preference made it difficult to receive radio signals when the transmitted fish occupied this type of habitat. Northern pike exhibited erratic movements and this trait made it difficult to track while surveying 200 miles of river and scanning 27 radios. Walleye and northern pike radio telemetry results will not be discussed in this report because of the lack of observations and the data sets will be on file.

A total of 9 of the 13 sauger had reasonably complete tracking records and the following results and discussion are based on these fish. The study area was divided into 3 segments (upper-river, mid-river and lower-river), with 3 fish represented in each segment, so that the radio-tagged sauger could be evaluated for place of residence and what effects this has on their movement patterns. Table 9 summarizes the individual radio telemetry results. The upper-river sauger demonstrated the greatest distance moved averaging 12.7 miles between relocations. Sixty-three percent of the relocations for this group of sauger were in the downstream direction. The greatest maximum distance moved was also recorded for this group where 2 of the 3 sauger moved over 90 miles downriver in 5-7 months. The mid-river sauger group showed an intermediate movement characteristics from that of the other two groups. The average distance moved was 6.4 miles with 60% of the time being stationary or moving in the upstream direction. The lower-river sauger group were relatively sedentary, showing no change in position 43 % of the time.

Seasonal movements of radio-tagged sauger are given in Table 10. The upper-river and mid-river sauger groups moved the greatest average distances during the spring 1998 and least in the fall 1998. The lower-river group was relatively sedentary and never averaged more than 1.8 miles difference between relocations. Radio-tagged sauger from the upper-river and mid-river groups moved the greatest distances during the spring 1998 period where the distances moved between locations averaged 23.1 and 13.6 miles, respectively. It appeared that sauger from the upper-river and middle river areas migrated to downstream spawning area(s) during April/May, returning back upstream during May/June. Figure 2 depicts 4 movement patterns that were characteristic of the 9 sauger monitored. Four of the 9 radio-tagged sauger monitored displayed a movement pattern similar to plot # 2. Totals of 1, 1 and 3 sauger displayed plot numbers' 1, 3 and 4 types of movement patterns. This data indicates that a large segment of the spawning sauger population require nearly 100 miles of open passage to complete their life cycle. It was interesting to note that not one of these 9 radio-tagged sauger migrated into the Marias River during the spawning period. Gardner and Berg (1982), conducting fisheries surveys in the late 1970's, indicated that great numbers of sauger migrated into the Marias River during the spawning period. Recent information (this study and Gardner 1998) indicates that sauger continue to spawn in the Marias, although at a much reduced level.

Table 10 indicates that sauger are the least active in the fall. The radio-tagged sauger moved less than an average of 3 miles/ relocation for all sauger groups, with the exception of the upper-river group during fall, 1997. This information indicates that fall is the most reliable time to conduct abundance surveys because the confounding effects of fish emigration and immigration are at a minimum.

Table 9. Summary statistics for the 9 radio-tagged sauger having complete relocation records, middle Missouri River, October, 1997 through October, 1998.

Fish identification Number	Number of Contacts	Number of Relocations			Average Distance Moved From Previous Contact (mi)	Maximum Distance Moved From Release Site (mi)
		Downriver From a Previous Contact	Upriver From a Previous Contact	No change From a Previous Contact		
Upper-river sauger						
120	9	5	3	1	3.7	15.0 down
519	10	6	3	1	15.7	99.9 down
680	5	3	1	1	18.8	90.0 down
Mid-river sauger						
601	12	4	5	3	9.6	55.1 down
701	12	4	2	6	7.2	37.3 down
761	11	6	3	2	2.5	11.5 down
Lower-river sauger						
100	12	3	4	5	0.7	3.6 down
161	5	0	1	4	0.2	1.2 up
202	4	2	2	0	8.2	9.7 down

Table 10. Average distances moved (mi) and range (in parentheses) of radio-tagged sauger monitored in the middle Missouri River, October, 1997 to October, 1998.

Sauger group	Average distance moved (mi) between previous contact		
	Fall 1997	Spring 1998	Fall 1998
Upper-River	14.2 (3.4 - 40.8)	23.1 (1.0 - 65.9)	1.4 (0.4 - 2.9)
Mid-River	2.2 (0.1 - 4.4)	13.6 (0 - 39.3)	1.5 (0 - 6.5)
Lower-River	1.8 (0.1 - 9.7)	1.6 (0.1 - 8.0)	Only one relocation

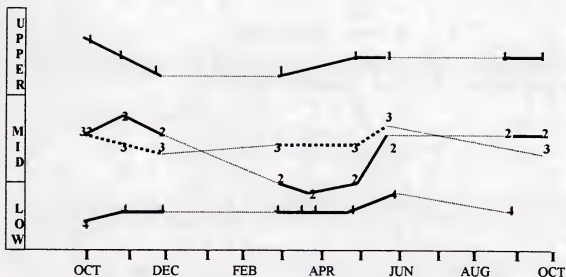


Figure 2. Movement patterns of 10 radio-tagged sauger monitored in the Middle Missouri River, October, 1997 to October, 1998. Vertical axis is river mileage (origin is 20 miles downstream of Robinson Bridge).

RECOMMENDATIONS

1. Continue with evaluating the sauger population status. Baseline sampling for sauger abundance should continue in the 4 trend areas (Coal Banks, Judith Landing, Grand Island and Marias River Confluence) and another upstream one should be added if time allows. The minimum amount of effort required to obtain an accurate estimate of abundance should be determined for these trend areas. Until this is known approximately 10 hours of sampling should be completed in each trend area. More emphasis should be directed at delineating locations and habitat parameters of sauger rearing areas. This will require a greater seining effort than what has been dedicated in the past. Sauger spawning areas should be sampled for evaluating the spawning population size and other areas should be surveyed to delineate the locations of additional areas.
2. Continue with the sauger supplementation program. Spawning sauger in the wild should be attempted again using eggs and sperm only from genetically screened fish.
3. Develop an endangered species and species of special concern monitoring program for tracking the population status of these sensitive species. The pallid sturgeon (federally listed), sicklefin chub and sturgeon chub (presently listed as species of special concern and federal candidates for listing), blue sucker and paddlefish (both species of special concern) are found in the study area. The pallid sturgeon and paddlefish already have a monitoring program in place. A monitoring program should be developed for the remaining 3 species.

ACKNOWLEDGEMENTS

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Prepared by: William M. Gardner

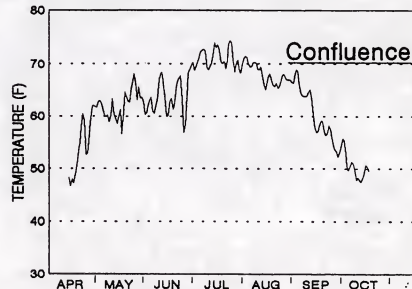
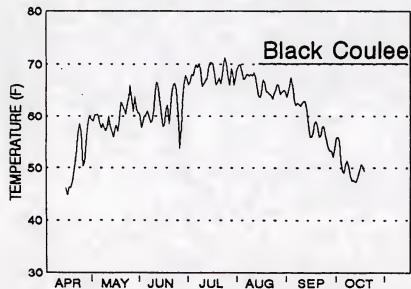
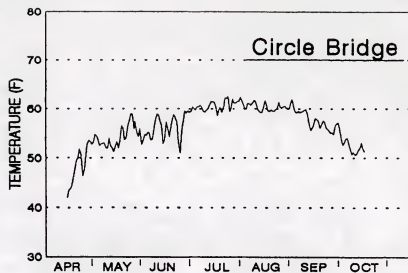
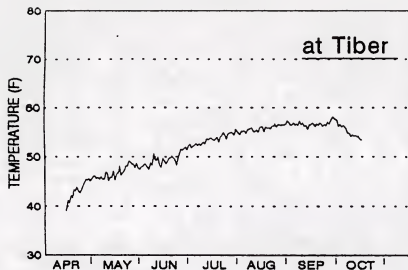
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Appendix A. Schedule for monitoring the radio tagged sauger, walleye and northern pike in the middle Missouri River, 1997-98.

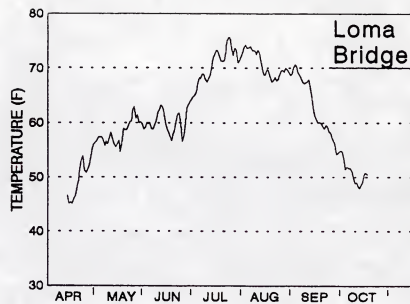
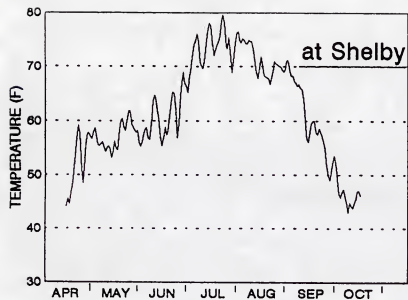
Broadcast period	Dates surveyed
Sept 17 -- Dec 15, 1997	Sept 18, 24, 29 Oct 1, 2, 3, 6, 7, 8, 9, 10, 14, 16, 20, 22, 27, 29 Nov 3, 4, 5, 7, 11 Dec 3, 5, 8
Mar 20 -- Jun 19, 1998	Mar 21, 26, 31 Apr 1, 11, 16, 21, 28 May 4, 6 Jun 2, 3, 15, 16, 17, 18, 19
Sept 17 -- Dec 15, 1998	Sept 22, 23, 24, 28, 29 Oct 1, 6, 8, 9, 15, 16, 27, 29 Nov 4

Appendix B. Locations and rivermile boundaries of study sections in the middle Missouri River study area.

Section	Rivermile	Location
Fort Benton	2073.4 to 2051.2	N47° 48.57 / W110° 40.02 to N47° 55.22 / W110° 29.35
Loma	2051.2 to 2024.0	N47° 55.22 / W110° 29.35 to N48° 01.00 / W110° 07.20
White Rocks	2024.0 to 1984.3	N48° 01.00 / W110° 07.20 to N47° 44.17 / W109° 38.02
Stafford Ferry	1984.3 to 1944.0	N47° 44.17 / W109° 38.02 to N47° 47.33 / W108° 56.47
Robinson Bdg.	1944.0 to 1892.7	N47° 47.33 / W108° 56.47 to N47° 34.53 / W108° 16.44



Appendix c Average daily water temperatures for the Marias and Missouri rivers, 1998.
 (Marias River stations are: Tiber @ RM 75.1; Circle @ RM 57.9; Black Coulee @ RM 28.5; Confluence @ RM 1.0; Shelby @ RM 116.8.
 Missouri River station is Loma @ RM 2052.8).



Appendix C. (Continued)

Appendix Table D. Summary size statistics for fish sampled with electrofishing in the upper Missouri river, MT, 1997.

Species/Station	Number	Avg. Total Length (inches)	Range	Avg. Weight (pounds)	Range
Black crappie					
Coal Banks	1	--	9.3	--	0.26
Judith Landing	12	8.0	(6.8 - 8.6)	0.32	(0.20 - 0.39)
Blue sucker					
Judith Landing	1	--	28.5	--	6.40
Grand Island	1	--	31.8	--	8.90
Brown trout					
Loma	2	17.3	(11.7 - 23.0)	2.90	(0.64 - 5.15)
Burbot					
Judith Landing	2	18.5	(18.0 - 19.0)	0.96	(0.87 - 1.05)
Grand Island	2	7.7	(6.6 - 8.8)	0.12	(0.05 - 0.20)
Carp					
Fort Benton	43	23.4	(10.0 - 29.0)	6.97	(0.55 - 10.90)
Loma	17	21.9	(18.2 - 28.0)	5.41	(3.00 - 9.90)
Coal Banks	57	21.4	(16.0 - 26.2)	4.93	(2.10 - 8.96)
Judith Landing	13	20.7	(18.3 - 24.9)	4.47	(3.20 - 7.80)
Grand Island	25	21.5	(12.3 - 26.2)	4.99	(1.04 - 8.25)
Channel catfish					
Fort Benton	2	19.1	(14.2 - 24.0)	3.74	(1.48 - 6.00)
Coal Banks	11	17.6	(14.8 - 23.4)	2.06	(0.94 - 5.85)
Judith Landing	15	21.4	(14.6 - 31.8)	4.92	(1.00 - 17.70)
Grand Island	12	21.8	(16.9 - 30.4)	5.17	(1.75 - 13.30)

Appendix Table D. (continued)

Species/Station	Number	Avg. Total Length (inches)	Range	Avg. Weight (pounds)	Range
Chinook salmon					
Judith Landing	1	--	32.2	--	15.2
Flathead chub					
Fort Benton	1				
Loma	48	5.0	(3.6 - 7.2)		(0.00 - 0.30)
Coal Banks	10	5.2	(3.6 - 7.4)		
Judith Landing	1	--	4.0		
Grand Island	5	5.1	(3.6 - 7.0)		
Freshwater drum					
Fort Benton	11	14.6	(11.4 - 20.9)	1.89	(0.80 - 4.40)
Coal Banks	33	11.7	(9.1 - 18.7)	0.90	(0.41 - 3.35)
Judith Landing	2	15.8	(15.0 - 16.7)	2.07	(1.50 - 2.65)
Grand Island	3	12.6	(11.9 - 13.6)	1.04	(0.90 - 1.33)
Goldeye					
Fort Benton	38	12.6	(10.4 - 15.4)	0.80	(0.60 - 1.40)
Loma	4	13.2	(12.1 - 13.8)	0.89	(0.75 - 1.05)
Coal Banks	37	12.5	(11.0 - 14.8)	0.72	(0.41 - 1.10)
Judith Landing	3	13.1	(12.5 - 13.6)	0.85	(0.75 - 0.95)
Grand Island	70	9.7	(4.5 - 14.5)	0.43	(0.05 - 1.00)
Longnose sucker					
Fort Benton	12	10.1	(5.4 - 16.4)	0.92	(0.30 - 2.69)
Loma	6	11.4	(3.2 - 18.5)	1.13	(0.01 - 2.95)
Coal Banks	6	9.5	(3.2 - 16.3)	0.71	(0.06 - 1.80)

Appendix Table D. (continued)

Species/Station	Number	Avg. Total Length (inches)	Range	Avg. Weight (pounds)	Range
Mountain whitefish					
Fort Benton	2	4.4	(4.3 - 4.4)	0.20	
Loma	2	12.0		0.80	
Northern Pike					
Fort Benton	2	32.0	(28.7 - 35.2)	11.40	(11.00 - 11.70)
Coal Banks	6	23.6	(19.6 - 28.0)	3.16	(1.85 - 4.67)
Judith Landing	8	19.1	(14.8 - 27.7)	2.39	(0.83 - 5.80)
Grand Island	5	16.7	(12.1 - 25.4)	1.40	(0.50 - 3.56)
Rainbow trout					
Fort Benton	3	17.7	(12.5 - 20.3)	2.31	(0.88 - 3.05)
Loma	4	19.7	(17.6 - 21.0)	3.15	(1.60 - 3.70)
Coal Banks	1	--	23.8	--	5.95
Judith Landing	5	21.1	(19.2 - 23.5)	4.43	(3.00 - 7.00)
River carpsucker					
Fort Benton	20	17.4	(14.3 - 20.3)	2.55	(1.58 - 3.64)
Loma	7	18.0	(17.1 - 18.8)	2.79	(2.30 - 3.45)
Coal Banks	52	17.6	(7.2 - 21.8)	2.84	(0.49 - 5.15)
Judith Landing	30	18.3	(14.7 - 23.5)	3.41	(1.90 - 6.93)
Grand Island	44	18.1	(14.3 - 22.5)	3.06	(1.58 - 5.85)

Appendix Table D. (continued)

Species/Station	Number	Avg. Total Length (inches)	Range	Avg. Weight (pounds)	Range
Sauger					
Fort Benton	3	13.5	(10.4 - 16.9)	0.82	(0.32 - 1.25)
Loma	3	15.2	(12.3 - 18.9)	1.09	(0.57 - 1.75)
Coal Banks	37	13.0	(8.5 - 18.9)	0.77	(0.20 - 2.35)
Judith Landing	34	14.0	(6.5 - 21.0)	1.09	(0.15 - 3.20)
Grand Island	31	13.1	(5.7 - 21.2)	0.92	(0.05 - 3.05)
Saugeye					
Grand Island	1	--	10.0	--	0.30
Shorthead redhorse					
Fort Benton	125	17.2	(9.3 - 30.4)	2.34	(0.40 - 4.18)
Loma	52	16.9	(5.5 - 20.0)	2.28	(0.18 - 3.45)
Coal Banks	129	14.1	(3.5 - 20.4)	1.53	(0.05 - 3.75)
Judith Landing	82	15.7	(4.6 - 19.3)	1.80	(1.80 - 3.28)
Grand Island	40	13.4	(4.8 - 17.3)	1.07	(0.10 - 2.15)
Shovelnose sturgeon *					
Coal Banks	1	--	31.0	--	4.78
Smallmouth bass					
Fort Benton	2	8.2	(4.7 - 11.6)	0.72	(0.20 - 1.24)
Loma	1	--	8.6	--	0.50

Appendix Table D. (continued)

Species/Station	Number	Avg.Total Length (inches)	Range	Avg. Weight (pounds)	Range
Smallmouth buffalo					
Fort Benton	1	--	22.7	--	6.00
Loma	1	--	23.5	--	7.85
Coal Banks	2	19.6	(19.5 - 19.6)	3.82	(3.05 - 4.60)
Grand Island	2	17.1	(15.5 - 18.7)	2.88	(2.22 - 3.54)
Walleye					
Fort Benton	5	12.6	(5.7 - 16.5)	0.91	(0.05 - 1.90)
Loma	10	13.2	(7.1 - 15.6)	0.97	(0.15 - 1.54)
Coal Banks	17	12.1	(4.7 - 24.0)	0.75	(0.02 - 3.95)
Judith Landing	9	13.0	(6.5 - 19.0)	0.86	(0.05 - 2.45)
Grand Island	10	12.8	(5.3 - 20.5)	0.99	(0.05 - 2.60)
White crappie					
Judith Landing	8	8.4	(7.9 - 8.9)	0.31	(0.25 - 0.32)
White sucker					
Fort Benton	12	14.9	(12.0 - 17.1)	1.62	(1.15 - 2.55)
Loma	1	--	9.7	--	0.63
Coal Banks	2	11.2	(6.5 - 15.8)	0.84	(0.15 - 1.54)
Judith Landing	2	13.0	(12.7 - 13.2)	1.06	(1.00 - 1.15)
Grand Island	2	9.4	(4.2 - 14.7)	0.60	(0.05 - 1.15)
Yellow perch					
Judith Landing	1	--	5.4	--	0.05
Grand Island	1	--	8.4	--	1.34

* Shovelnose sturgeon length measurement is a fork length.

Appendix Table E. Summary size statistics for fish sampled by electro-fishing, on the Missouri River, MT, fall 1998.

Species/Station	Number	Avg. Total Length (inches)	Range	Avg. Weight (pounds)	Range
Black Crappie					
Judith Landing	2	8.8	(8.6 - 8.9)	0.45	(0.40 - 0.50)
Grand Island	23	8.4	(6.0 - 9.5)	0.34	(0.20 - 0.55)
Blue Sucker					
Coal Banks	8	28.9	(26.3 - 32.8)	8.47	(5.80 - 12.85)
Judith Landing	1	--	31.5	--	11.95
Brown Trout					
Marias R.	1	--	9.3	--	0.40
Burbot					
Coal Banks	2	12.9	(11.5 - 14.4)	0.33	(0.28 - 0.38)
Judith Landing	4	12.7	(10.3 - 13.6)	0.45	(0.25 - 0.60)
Grand Island	2	11.0	(7.5 - 14.5)	0.23	(0.10 - 0.36)
Carp					
Marias R.	3	16.1	(11.6 - 19.6)	2.41	(0.08 - 3.51)
Coal Banks	36	21.1	(14.4 - 26.5)	4.68	(1.55 - 8.50)
Judith Landing	38	20.1	(14.9 - 27.0)	4.03	(1.72 - 9.95)
Grand Island	11	21.6	(14.8 - 25.6)	5.29	(1.94 - 9.00)

Appendix Table E. (continued)

Species/Station	Number	Avg. Total Length (inches)	Range	Avg. Weight (pounds)	Range
Channel catfish					
Coal Banks	10	20.3	(15.4 - 27.8)	4.03	(1.33 - 10.90)
Judith Landing	15	18.7	(14.1 - 34.0)	3.23	(0.85 - 20.00)
Grand Island	45	20.1	(14.5 - 30.5)	3.19	(0.80 - 12.80)
Flathead Chub					
Marias R.	14	6.6	(4.2 - 8.6)	--	--
Coal Banks	5	5.7	(5.2 - 6.4)	--	--
Judith Landing	24	6.1	(3.6 - 10.6)	--	--
Grand Island	3	7.0	(5.5 - 8.5)	--	--
Freshwater Drum					
Marias R.	1	--	12.6	--	1.00
Coal Banks	61	12.1	(9.2 - 14.9)	0.91	(0.47 - 1.70)
Judith Landing	23	11.6	(7.7 - 14.0)	0.81	(0.41 - 1.25)
Grand Island	2	13.4	(12.8 - 14.0)	1.12	(1.00 - 1.24)
Goldeye					
Marias R.	40	12.2	(8.8 - 14.0)	0.68	(0.30 - 1.25)
Coal Banks	119	12.6	(7.9 - 14.3)	0.74	(0.22 - 1.24)
Judith Landing	130	11.8	(7.5 - 14.0)	0.60	(0.25 - 1.02)
Grand Island	39	12.5	(10.7 - 14.3)	0.66	(0.50 - 1.07)
Hybognathus					
Coal Banks	1	--	4.7	--	--

Appendix Table E. (continued)

Species/Station	Number	Avg. Total Length (inches)	Range	Avg. Weight (pounds)	Range
Longnose Sucker					
Marias R.	18	9.7	(5.7 - 16.5)	0.58	(0.32 - 1.80)
Coal Banks	17	11.0	(4.4 - 17.1)	0.74	(0.10 - 1.92)
Judith Landing	5	8.8	(4.4 - 14.5)	0.48	(0.13 - 1.25)
Grand Island	2	12.2	(8.2 - 16.3)	0.86	(0.12 - 1.60)
Mountain Whitefish					
Marias R.	4	6.9	(4.6 - 9.8)	0.21	(0.10 - 0.45)
Coal Banks	1	--	5.8	--	0.21
Judith Landing	1	--	9.0	--	0.40
Northern Pike					
Marias R.	6	24.6	(18.6 - 30.6)	3.40	(1.65 - 5.80)
Coal Banks	3	23.8	(20.7 - 29.3)	3.38	(2.22 - 5.75)
Judith Landing	4	24.6	(19.1 - 29.8)	3.68	(1.50 - 6.00)
Grand Island	5	24.4	(22.8 - 27.3)	3.33	(2.42 - 5.11)
Rainbow Trout					
Grand Island	2	22.6	(20.1 - 25.1)	6.50	(3.80 - 9.20)
River Carpsucker					
Coal Banks	34	17.3	(15.0 - 20.3)	2.57	(1.73 - 4.60)
Judith Landing	26	18.1	(14.9 - 22.2)	3.04	(1.70 - 6.73)
Grand Island	47	18.7	(14.4 - 23.4)	3.62	(1.72 - 7.40)

Appendix Table E. (continued)

Species/Station	Number	Avg. Total Length (inches)	Range	Avg. Weight (pounds)	Range
Sauger					
Marias R.	136	10.9	(8.3 - 20.3)	0.45	(0.24 - 2.61)
Coal Banks	32	11.4	(6.9 - 18.6)	0.62	(0.10 - 2.12)
Judith Landing	47	11.6	(5.9 - 20.5)	0.60	(0.12 - 2.80)
Grand Island	86	12.3	(6.4 - 21.2)	0.59	(0.10 - 2.92)
Saugeye					
Marias R.	17	12.6	(9.1 - 18.2)	0.68	(0.23 - 1.84)
Grand Island	8	20.6	(7.3 - 16.0)	1.49	(0.12 - 3.30)
Shorthead redhorse					
Marias R.	43	12.3	(5.2 - 20.1)	1.26	(0.10 - 3.48)
Coal Banks	137	13.6	(3.9 - 20.6)	1.36	(0.07 - 3.32)
Judith Landing	98	14.8	(5.5 - 20.5)	1.56	(0.11 - 3.18)
Grand Island	44	11.5	(4.0 - 17.3)	0.85	(0.10 - 2.22)
Shovelnose sturgeon *					
Coal Banks	1	--	34.5	--	8.38
Smallmouth Bass					
Coal Banks	1	--	7.3	--	1.28
Smallmouth buffalo					
Coal Banks	16	23.4	(16.2 - 30.0)	8.58	(2.68 - 15.50)
Judith Landing	6	22.9	(17.3 - 30.1)	9.00	(2.72 - 17.30)
Grand Island	1	--	29.3	--	14.70

Appendix Table E. (continued)

Species/Station	Number	Avg. Total Length (inches)	Range	Avg. Weight (pounds)	Range
Stonecat					
Marias R.	1	--	7.1	--	
Grand Island	2	5.9	(5.5 - 6.2)	--	--
Walleye					
Marias R.	34	1.30	(11.4 - 16.5)	0.80	(0.47 - 1.63)
Coal Banks	12	13.4	(10.9 - 17.3)	0.88	(0.50 - 1.75)
Judith Landing	12	13.5	(9.3 - 15.8)	0.80	(0.32 - 1.30)
Grand Island	5	15.3	(13.0 - 18.0)	1.22	(0.90 - 1.80)
White Crappie					
Judith Landing	2	8.8	(8.6 - 8.9)	0.31	(0.31 - 0.32)
White sucker					
Marias R.	12	11.0	(3.0 - 14.8)	0.87	(0.10 - 1.83)
Coal Banks	1	--	12.6	--	0.87
Judith Landing	2	11.2	(6.0 - 16.3)	0.88	(0.10 - 1.70)
Yellow Perch					
Marias River	4	5.8	(5.2 - 6.5)	0.14	(0.09 - 0.20)
Coal Banks	1	--	6.1	--	0.20
Judith Landing	3	8.3	(8.2 - 8.3)	0.29	(0.25 - 0.33)

* Shovelnose sturgeon length measurement is a fork length.